ASJ: *International Journal of Health, Safety and Environments (IJHSE)*
Vol. 3(3) 26 May, 2017, Pp. 35-47
www.academiascholarlyjournal.org/ijhse/index_ijhse.htm
ISSN: 2360-9311©Academia Scholarly Journals
Indexed In: Directory of Research Journals Indexing - http://www.drji.org
Also Available@; https://archive.org/details/ Abere _et_al
Open access

Full Length Research

Safety Culture Assessment of Workers in a Pipeline Construction Site in Nigeria

[1]Abere Belema, [1*]Nwaogazie Ify L and [1]Akaranta Onyewuchi

[1]Centre for Occupational Health, Safety and Environment, University of Port Harcourt, Nigeria.

Accepted May, 20, 2017

The study investigated the safety awareness amongst workers in a pipeline construction site. A safety culture assessment questionnaire was adopted for the study. A total of 134 workers were assessed with respect to safety management, actively caring and safety perception. Demographic information on respondents were equally obtained. The safety awareness level among the respondents was found to be higher with Welders and Fitters. It was found that Grinders and Wrappers had low awareness levels on safety related practices; chances of developing at-risk behaviors leading to reduced safety performance and the likelihood of injuries, ill-health and accidents on site. The safety awareness level of pipeline industry workers demonstrated that a group of workers (Welders and Fitters) due to their in-depth industry training curriculum; inclusive of safety standards and specification, exhibited higher safety awareness than other groups of pipeline workers (Grinders and Wrappers).

Keywords: Safety Culture, Actively Caring, Safety Perception, pipeline workers, Construction site, Nigeria.

INTRODUCTION

Research studies have shown that performance in organizations varies according to types of organizational cultures based on the competing values framework classification (Yeung et al., 1991). The concept of organizational culture has been extensively studied in the last two decades, and it is widely acknowledged that this concept is a critical determinant of an organization's success or failure. Schein (2004) suggested that it is easy to observe what happens in an organization, for example poor marketing, leadership failures and so on but, in the effort to understand why such things happen, "culture as a concept" comes into play.

***Corresponding Author's Email: ifynwaogazie@yahoo.com**

Many organizational culture definitions have been suggested, for example, Hofstede and Hofstede (2005) called it "the collective programming of the mind that distinguishes the member of one organization from another". Historically, the term "safety culture" was first used in 1986 in an International Safety Advisory meeting following an accident. Since then, the term has multiple meanings; there is not a universal definition for safety culture (Rao, 2007). According to Guldenmund (2007), safety culture has been well studied; yet, researchers have not reached a consensus on what constitute a safety culture.

In the context of this study, it is important to clearly define what is meant by safety culture, as it is a recurrent theme in the research. The definition used

herein is “a belief, philosophy or faith held by groups of individuals on safety matters which is demonstrated in practice through the attitudes, actions and behaviour adopted by the people of an organization or a nation” (Kuo and Yen 2009). Research studies have shown safety culture dimensions ranging from management to risk awareness (Borjesson, 2008) and attitudes and perceptions of the safety climate. The commonly cited dimensions of a positive safety culture presented in a dissertation on predictors of work-related injuries (McConnell, 2004) include: commitment by management and workforce, leadership style and communication, individual responsibility, management responsibility, risk awareness and risk-bearing.

Some of the common components addressed in the definitions of “safety culture” include the following: safety management (Dongping and Chen, 2005), safety system (Choudhry et al., 2007), safety climate (Choudhry et al., 2007; Hale, 2000), safety management system (Hale, 2000; Diaz-Cabrera, 2007), socio-technical system (Grote and Künzler, 2000; Leveson et al., 2009) and behavior-based safety (Choudhry et al., 2007). Safety culture indicators are classified according to formal versus informal norms. The formal norms in a safety culture are characterized as written organizational safety policies and procedures, such as regulations, whereas the informal norms are not documented (Rao, 2007). He further contends that social networks and trust among employees are critical aspects of informal norms that frequently determine whether employees will make safety first.

The aim of this study is to perform a detailed examination of the safety culture at pipeline industry site. The study was developed with data collected from questionnaires that addressed certain safety culture dimensions. Quantitative and qualitative analyses were performed in an effort to examine relationships between the Safety culture of pipeline workers and their performance.

MATERIALS AND METHOD

This section covers the study area, method of data collection, procedure and data analysis. The details are as presented next.

Study Area

This study was carried out in an oil and gas sector. The location was on pipeline construction site for the Installation of gas flow line to a processing facility, located in an oil pipeline terminal in Niger Delta, Nigeria. The estimated terrain elevation above sea level is 7 metres. Latitude: 4°32'54.24" and Longitude: 8°0'45.72" (Figure 1).

Data Collection

Research Design, Procedure and Participants' Job Discription.

The primary data were collected by using questionnaire survey forms administered in a self-completion and structured interview format to the respondents. The questionnaire were pretested two weeks prior to the field data collection by testing it on twenty randomly selected workers from another pipeline organization to get their input and know where improvement could be made. The questionnaires were subsequently revised based on the information and feedback provided by the trial group. A total of one hundred and forty-five (145) questionnaires were distributed to the pipeline operations crew as target population. One hundred and forty-one (141) out of one hundred forty-five (145) questionnaires, were returned and completely filled while seven (7) crew members declined, hence one hundred and thirty-four (134) representing eighty nine percent (89%) of questionnaires distributed were analyzed.

For the purpose of assessing safety culture of 134 pipeline industry workers (permanent, temporary, and casuals) made up the study population. The entire pipeline construction workers comprising of 50 Welders, 20 Fitters, 20 Scaffolders, 44 Riggers at project site were included in the analysis. The following activities were carried out by these workers: - Excavation, De-coating, welding and Fabrications operations, Installations and tie-in, Field joint coatings, Erection and Dismantling of scaffolds, Backfilling and Site Restoration.

The study populations were male and female workers engaged by the company with minimum of 2 years project site experience. Workers include; Welders, Fitters, Grinders and Wrappers.

Figure 1: Map of Study Area, Eket, Nigeria, Source: Google Map, 2016.

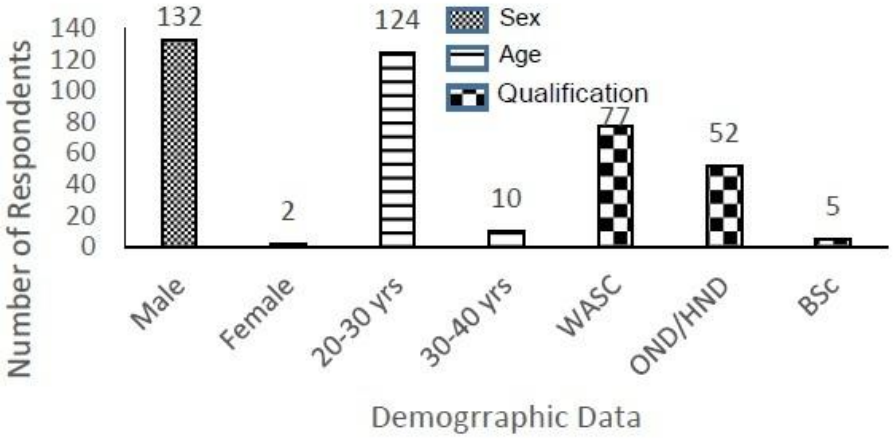

Figure 2. Demographic Characteristics.

The pipeline welder is skills-based, and is continually updated to reflect the best practices and able to meet the welding performance demands of industry like Pipe stringing, Pipeline Tie-in Techniques etc. The fitters measure and mark pipes for cutting or threading, Pipes alignment and fitting, Joining and Lines lowering etc. The Grinder cuts and grinds rough pipeline finishes, surfaces etc. Pipeline wrapper applies coating materials and wrappings to reduce corrosion of buried pipes. The administered questionnaire (see Appendix B) assessed the respondents' sex, age, and qualification. Figure 2 presents the summary distribution of bio-data for the pipeline workers (respondents).

Questionnaire

The safety culture questionnaire was used for collecting responses from the subject selected for the study. It assessed different employees' perceptions and opinions regarding how strongly

they believe them and others within the organization support safety, measures employee perceptions of many formal safety management systems and those instances of behavior which directly or indirectly impact on the safety of others. It consisted of twenty four (24) questions and has a completion time of approximately 10 minutes. It was designed in a multiple choice format. Questions had statements in a five point Likert scale (always, often, sometimes, seldom and never).

The questionnaires were based on information obtained in literature review. The questions were partly derived from already existing instruments and partially developed by us (the researchers) based on comprehensive study carried out by other researchers (Moller, 2003). This questionnaire-based instrument was designed to measure the content of a respondent's safety culture level in a general manner. The questionnaire scales of Safety Management System, Actively Caring and Safety Perception have been used to predict employee safety culture and organizational safety climate.

The questionnaire comprised of two major parts. Part A was on background information (bio-data) of the respondents. This part of the questionnaire was intended to elicit information about the sex, age, and educational qualification viz., i) secondary school certificate (West African School Certificate, WASC); ii) Intermediate Certificate (Ordinary and Higher National Diplomas, OND/HND); iii) first degree certificate (Bachelors of Science, BSc). Part B contained the safety culture questionnaire variables for the improvement process (Safety management, Active caring, Safety perception, etc.).

Data Analysis

In order to assess the level of unawareness among the different groups of workers within the study area Kendall w-statistic was employed. This checks the level of agreement with respect to safety practices within the construction site. Kendall's w-statistic according to Nwaogazie (2011) is a non-parametric statistic which is a normalization of Friedman test. It is usually employed to assess the agreement among raters. Its output (w, test statistic) ranges from zero which shows no agreement among the raters to unity which indicates complete agreement among the different raters. The intermediate values of w indicate high or low degree of unanimity among the respondents.

The formula employed in Kendall's coefficient of concordance (w) is given by Equations (1-4) (Dodge, 2003; Nwaogazie, 2011):

$$R_i = \sum_{j=1}^{m} r_{ij} \quad (1)$$

$$\overline{R} = \frac{1}{2} m(n+1) \quad (2)$$

$$S_d = \sum_{i=1}^{n} \left(R_i - \overline{R}\right)^2 \quad (3)$$

$$w = \frac{12 S_d}{m^2 n\left(n^2 - 1\right)} \quad (4)$$

where R_i = Total rank given to a parameter; $\overline{R}$ = mean value of the total ranks; S_d = sum of squared deviations; and w = Kendall's w – statistic.

XLSTAT 2016 statistical tool (computer software) was adopted in data analysis with respect to distribution fitting analysis/normality test using Chi-square test, χ^2 (see Figures 3a–d and Appendix A) and Kruskal-Wallis test statistic for *k* sample. The null, H_0 and alternative, H_1 hypotheses being tested by the Chi-square test χ^2 are as presented below:

$H_0 = The\ \ samples\ \ follow\ a\ normal\ distribution;\ and$
$H_1 = The\ samples\ do\ not\ \ follow\ a\ normal\ distribution$

This is to justify that the data set is fit for Kruskal-Wallis test of analysis of variance to determine if the differences in the level of awareness among the categories of workers are of significance.

The basic equation for Chi-squaretest χ^2 is presented by Equation (5):

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i} \quad (5)$$

Where subscript *c* = degree of freedom;

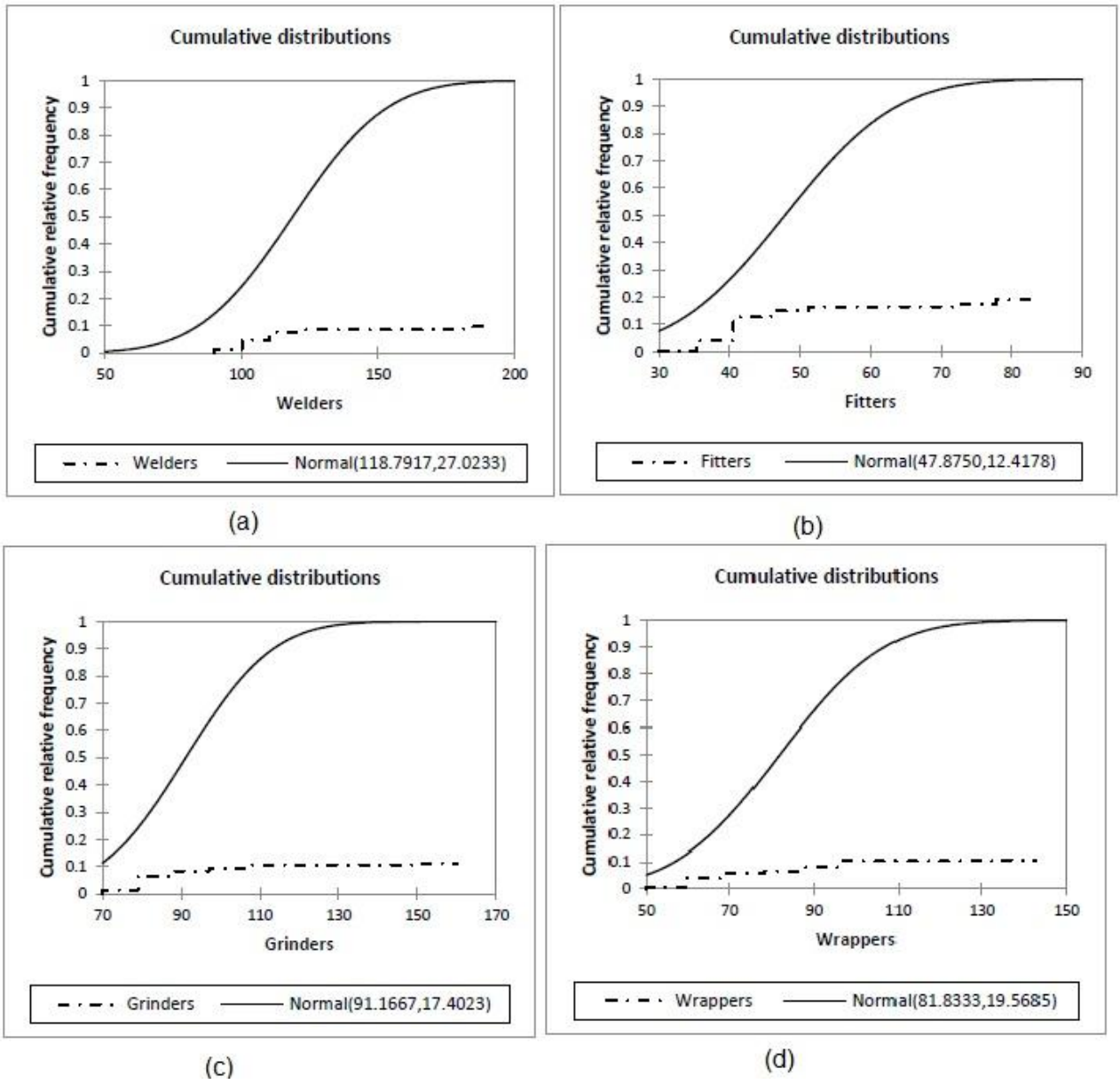

Figure 3(a-d). Normality Test for Questionnaire Respondents.

O = observed values; E = expected value

Note: Degree of freedom, $c = number\ of\ categories - 1$ (for this study, no. of categories = 4, thus, $c = 3$)

Kruskal-Wallis test statistic for *k* samples (each of size, n_i) is given as Equations (6)-(8).

$$K_{(critical)} = \frac{1}{S^2}\left[\sum_{i=1}^{k}\frac{R_i}{n_i} - N\frac{(N+1)^2}{4}\right] \quad (6)$$

$$S^2 = \frac{1}{N-1}\left[\sum_{all} R_{ij}^2 - N\frac{(N+1)^2}{4}\right] \quad (7)$$

Note: if there are no ties among the rankings of the

observations, Equation (6) *simplifies to:*

$$K_{(observed)} = \frac{12}{N(N+1)}\sum_{i=1}^{K}\frac{R_i^2}{n_i} - 3(n+1) \quad (8)$$

Where;
N =Questionnaire parameter × No. of Categories of respondents = 2×84 = 96;
R_i *= sum of ranks;*
n = total No. of tied sets from observations (Questionnaire parameters).

When the output from Kruskal-Wallis test is significant, then at least one of the respondent's category differs from the others. It is interesting to note that Kruskal-Wallis test does not identify where the difference occurs or how many differences actually occur. Thus, a test procedure for making pair-wise comparison is needed (Ostertagová et al., 2014). The multiple pairwise comparison method employed by the statistical tool was the Steel-Dwass-Critchlow-Fligner procedure/Two-tailed test. This is a more complex method as recommended by Hollander and Wolfe (1999). It involves the recalculation of the ranks for each combination of category of respondents. The w_{ij} statistic (see Appendix A, Table A5), which is the sum of the ranks for the *i*th category of respondent where questionnaire parameters for both categories have been ranked together is further calculated for each combination. XLSTAT then calculates the corresponding p-values using the asymptotic distribution.

By the Steel-Dwass-Critchlow-Fligner procedure (Critchlow and Flinger, 1991), a contrast is considered significant if the following inequality is satisfied:

$$w_{ij} = \frac{-n_i(n_i+n_j+1)/2}{\frac{n_i n_j}{24}\left[n_i+n_j+1-\frac{\sum_{b}^{g_{ij}}(t_b-1)t_b(t_b+1)}{(n_i+n_j)(n_i+n_j-1)}\right]} > q_{\alpha,k}, \quad for\ 1 \le i \le j \le k$$

Where *q* is a quantile from normal range distribution for *k* groups, n_i is size of the *i* th group, n_j is the size of the *j* th group, t_b is the number of ties at rank *b*.

RESULTS

On analyzing the collected data for the level of safety unawareness applying Kendall w-statistic, Tables 1-3 present the summary of analysis for the four groups of pipeline workers (Categories of respondents: Welders, Fitters, Grinders and Wrappers with respect to safety management practices, active caring and general safety perception, respectively). Figures 3(a –d) present the plots from the output of the normality test (using Chi-square test, see Appendix A, for Tables A1-A4) applied on the collected data with respect to the categories of questionnaire respondents by XLSTAT. It shows that the data are not normally distributed, hence the use of non-parametric analysis. On application of Kruskal-Wallis test of significance and multiple pair-wise comparison (Appendixes A5 and A6), while Tables 4 - 6 present the output of the analyses.

DISCUSSION

From the analysis of the collected data using Kendall w-statistic (Tables 1-3) the average value of the Kendall w-statistic among the various categories of respondents is relatively very high. In respect of general safety management (SM) that measures employee perceptions of many formal safety management systems, including discipline, safety rules and procedures, safety training, safety communication, safety suggestions, Fitters have the highest level of unawareness agreement of 99%, showing a low level of Safety management awareness, while Welders scored the least value of 94% level of unawareness indicating high awareness on safety management system (Table 2). This implies that the level of safety awareness among Welders is relatively higher than other group of workers; when it comes to general safety management. Furthermore, in the area of active caring, that measures behaviour which directly or indirectly impact on the safety of others. Respondents were asked whether they felt employees should perform the specific behaviour, whether they are willing to perform the behaviour and whether they do perform the behaviour (caution co-worker). Grinders and Wrappers have higher values of Kendall w-static (98 and 89%) as level of

Table 1. Kendall w-statistic to Respondents Level of Unawareness on General Safety Management.

QUESTIONNAIRE PARAMETER	WELDERS			FITTERS			GRINDERS			WRAPPERS		
	R_i	$\overline{R}$	$(R_i-\overline{R})^2$	R_i	$\overline{R}$	$(R_i-\overline{R})^2$	R_i	$\overline{R}$	$(R_i-\overline{R})^2$	R_i	$\overline{R}$	$(R_i-\overline{R})^2$
SMQ1±	109	225	13456	44	90	2116	85	180	9025	92	157.5	4290.25
SMQ2	114	225	12321	47	90	1849	90	180	8100	104	157.5	2862.25
SMQ3	112	225	12769	44	90	2116	90	180	8100	86	157.5	5112.25
SMQ4	113	225	12544	45	90	2025	84	180	9216	68	157.5	8010.25
SMQ5	104	225	14641	38	90	2704	83	180	9409	63	157.5	8930.25
SMQ6	126	225	9801	45	90	2025	107	180	5329	102	157.5	3080.25
SMQ7	120	225	11025	48	90	1764	106	180	5476	67	157.5	8190.25
SMQ8	113	225	12544	45	90	2025	81	180	9801	62	157.5	9120.25
TOTAL			99101			16624			64456			49596
W	0.943819			0.9895238			0.9591667			0.963965015		

SMQ1± = Questionnaire Parameter- 1 for Safety Management.

Table 2. Kendall w-statistic to Respondents Level of Unawareness on Active Caring.

QUESTIONNAIRE PARAMETER	WELDERS			FITTERS			GRINDERS			WRAPPERS		
	R_i	$\overline{R}$	$(R_i-\overline{R})^2$	R_i	$\overline{R}$	$(R_i-\overline{R})^2$	R_i	$\overline{R}$	$(R_i-\overline{R})^2$	R_i	$\overline{R}$	$(R_i-\overline{R})^2$
ACQ1±	191	225	1156	73	90	289	86	180	8836	101	157.5	3192.25
ACQ2	99	225	15876	36	90	2916	78	180	10404	59	157.5	9702.25
ACQ3	102	225	15129	45	90	2025	110	180	4900	99	157.5	3422.25
ACQ4	187	225	1444	78	90	144	80	180	10000	97	157.5	3660.25
ACQ5	106	225	14161	42	90	2304	89	180	8281	82	157.5	5700.25
ACQ6	109	225	13456	42	90	2304	85	180	9025	74	157.5	6972.25
ACQ7	97	225	16384	53	90	1369	89	180	8281	62	157.5	9120.25
ACQ8	114	225	12321	37	90	2809	100	180	6400	94	157.5	4032.25
TOTAL			89927			14160			66127			45802
W	0.8564476			0.8428571			0.9840327			0.890223518		

ACQ1± = Questionnaire Parameter-1 for Active Caring.

unawareness. This reflects their similarity and lower level of safety awareness than Welders and Fitters (85 and 84%, Table 3).

Next, with regards to Safety perception, Fitters and Welders recorded 91 and 93% degree of concordance of unawareness, showing more awareness on Safety perception than Wrappers and Grinders which ranked the highest (98 and 97%) (Table 4). On applying normality test on the collected data to ascertain their fitness for analysis of variance using Krukal-Wallis test of significance, the normality test showed that the data are not normally distributed (Figure 3). Thus, analysis of variance using Kruskal-Wallis test, was applied to see if the various levels of unawareness is statistically significant among the various respondents. Kruskal-Walli's test of significance revealed that there are significant differences between the levels of safety awareness among the various pipeline workers.

Table 3. Kendall w-statistic to Respondents Level of Unawareness on Safety Perception.

QUESTIONNAIRE PARAMETER	WELDERS			FITTERS			GRINDERS			WRAPPERS		
	R_i	$\overline{R}$	$(R_i-\overline{R})^2$	R_i	$\overline{R}$	$(R_i-\overline{R})^2$	R_i	$\overline{R}$	$(R_i-\overline{R})^2$	R_i	$\overline{R}$	$(R_i-\overline{R})^2$
SPQ1±	104	225	14641	48	90	1764	80	180	10000	70	157.5	7656.25
SPQ2	110	225	13225	42	90	2304	85	180	9025	68	157.5	8010.25
SPQ3	112	225	12769	45	90	2025	79	180	10201	72	157.5	7310.25
SPQ4	107	225	13924	36	90	2916	102	180	6084	77	157.5	6480.25
SPQ5	95	225	16900	52	90	1444	84	180	9216	68	157.5	8010.25
SPQ6	122	225	10609	45	90	2025	78	180	10404	90	157.5	4556.25
SPQ7	180	225	2025	82	90	64	159	180	441	142	157.5	240.25
SPQ8	105	225	14400	37	90	2809	78	180	10404	65	157.5	8556.25
TOTAL			98493			15351			65775			50820
W	0.938028571			0.91375			0.978794643			0.987755102		

SPQ1± = Questionnaire Parameter-1 for Safety Perception.

Table 4. Kruskal-Wallis test of significance.

K (Observed value)	69.6333
K (Critical value)	7.8147
DF	3
p-value (Two-tailed)	< 0.0001
Alpha	0.05

Note: An approximation has been used to compute the p-value and Ties have been detected in the data and the appropriate corrections have been applied.

These differences were confirmed by the multiple pair-wise comparisons using the Steel-Dwass-Critchlow-Fligner procedure (Tables 5 and 6). However, the procedure revealed that there was no significant difference between the safety awareness level of Wrappers and Grinders (Table 6). As they adopted similar belief, philosophy on safety matters which is demonstrated in practice through their attitudes, actions and behaviours. This implies that the Wrappers and Grinders in a way shared similar safety cultural practices and actions regarding one's personal safety and others' safety, management commitment and safety interventions which are different from the Welders and Fitters. This is as a result of their robust training (Welders and Fitters) with regulatory safety procedure, continually updated to reflect the best industrial practices.

CONCLUSION

Based on the results of this study, the following conclusions can be drawn:

i) The level of safety awareness among Welders is relatively higher than other group of workers; when it comes to general safety management;

ii) In the area of active caring Grinders and Wrappers have a higher value of Kendall w-static (98 and 89%) reflecting their similarity and low level of safety awareness than Welders and Fitters (85 and 84%);

iii) The Safety perception awareness, of Fitters and Welders (91 and 93%) were higher than Wrappers and Grinders that ranked (98 and 97%);

iv) Safety culture and shared beliefs have an impact on the perception of risks, and the knowledge of this correlation would give pipeline workers an insight into where they

Table 5. Multiple pairwise comparisons using the Steel-Dwass-Critchlow-Fligner procedure.

Sample	Frequency	Sum of ranks	Mean of ranks	Groups		
Fitters	24	346.0000	14.4167	A		
Wrappers	24	1066.0000	44.4167		B	
Grinders	24	1307.5000	54.4792		B	
Welders	24	1936.5000	80.6875			C

Table 6. Significant differences from multiple pair-wise comparison.

	Welders	Fitters	Grinders	Wrappers
Welders		**Yes**	**Yes**	**Yes**
Fitters	**Yes**		**Yes**	**Yes**
Grinders	**Yes**	**Yes**		No
Wrappers	**Yes**	**Yes**	No	

need to put 'safety barriers' to reduce the likelihood of an incident.

v) In the pipeline industry the welder followed by the fitter have in-depth training curriculum and industry standards specification than Grinder and Wrapper in which most of the entries are through apprenticeship programs, hence their high risk perception and the level of safety awareness at site;

vi) Health and safety are strongly linked to the success of pipeline activities, as there can be no successful operation if it is not also incident free.

RECOMMENDATIONS

As a result of this study, the following recommendations are made:

i) For a more proactive safety culture, a behavioral based safety program should be implemented; by peer to peer observation of workers' safe and at-risk behavior; coaching and giving feedback, thereby gaining trust and improving on the safety culture and performance.

ii) There is need to establish a site-specific Health and Safety awareness on the pipeline activities; this will be carried out by discussing a Job Hazard Analysis (JHA) with all group workers. This will constantly refresh workers awareness on the safety procedures at site, invariably increasing their awareness level daily.

iii) For enhanced occupational health and safety culture in the pipeline industry, basic safety procedures, practices and regulations should be inclusive in the curriculum of all pipeline related trainings and education for all groups of pipeline workers.

iv) In achieving a more positive safety culture, a Health and Safety Officer should mandatorily be on site; to ensure compliance with safety policies and procedures.

v) Establish, Implement and Maintain Pipeline safety as a prospective area of Occupational health and Safety practice in Nigeria; as in the likes of Construction safety, Offshore Safety, Medical Safety, Process Safety etc.

REFERENCES

Borjesson M (2008). Leadership and safety culture: Karolinska Institute.

Burke WW (2008). Organization change: Theory and practice (2nd ed.). Los Angeles: Sage Publications.

Choudhry RM, Dongping F and Mohamed S (2007). Developing a model of construction safety culture. J. Manag. Eng., 23(4): 207-212.

Critchlow DE and Flinger MA (1991). On distribution-free multiple comparisons in the one-way analysis of variance. Communications in Statistics – Theory and Methods; 20:127-139.

Diaz-Cabrera D (2007). Organizational Practices Instrument Manual. In L. University (Ed.), (pp. 1-26). Tenerife: Adams.

Dodge Y (2003). The Oxford Dictionary of Statistical Terms, Oxford University Press, Oxford. ISBN 0-19- 850994-4

Dongping F and Chen Y (2005). The performance evaluation and construction of safety culture in Construction Industry. Construct. Econ., 41-45 (In Chinese).

Grote G, Künzler C (2000). Diagnosis of safety culture in safety management audits. Safety Sci. 34: 131-150.

Guldenmund F (2007). The use of questionnaires in safety culture research - an evaluation. Safety Sci., 45(6): 723-743 doi: 10.1016/j.ssci.2007.04.006 http://dx.doi.org/10.1016/j.ssci.2007.04.006

Hale AR (2000). Editorial: culture's confusions. Safety Sci. 34: 1-14

Hofstede G and Hofstede GJ (2005). Cultures and Organizations: Software of the Mind (Rev. 2nd ed.). New York: McGraw-Hill.

Hollander M and Wolfe D (1999). Nonparametric statistical methods. 2nd ed. New York: Wiley.

Kuo Y- F and Yen S- N (2009). “Towards an Understanding of the Behavioral Intention to Use 3G Mobile Value-Added Services,” Computers in Human Behavior, 25: 103-110.

Leveson N, Dulac N, Marais K and Carroll J (2009). Moving Beyond Normal Accidents and High Reliability Organizations: A Systems Approach to Safety in Complex Systems. Organ. Stud., 30(2-3): 227-249.

McConnell CW (2004). Predictors of work injuries: A quantitative exploration of level of English proficiency as a predictor of work injuries in the construction industry. Colorado State University Retrieved from http://0proquest.umi.com.catalog.library.colostate.edu/pqdweb?did=862896621&Fmt=7&clientI14436&RQT=309&VName=PQD.

Moller GP (2003). The Implementation and Evaluation of a Behaviour Baed Safety Intervention at Sishen Iron Ore Mine. Thesis submitted in fulfillment of the requirement of the degree Philosophiae Doctor in Industrial Psychology at the Potchefstroomse Univeriteit vir Christelike Hoer Onderwys.

Nwaogazie IL (2011). Probability and Statistics for Science and Engineering practice, 3rd edition, De-Adriot Innovation Publishers, Enugu Nigeria.

Ostertagová E, Ostertag O and Kováč J (2014). Methodology and Application of the Kruskal-Wallis Test. Applied Mechanics and Materials, Trans Tech Publications, Switzerland. 611: 115 – 120.

Rao S (2007). Safety culture and accident analysis-A socio-management approach based on organizational safety social capital. J Hazardous Mater., 142(3): 730 - 740

Schein EH (2004). Organizational Culture and Leadership, third ed. Jossey-Bass, San Francisco.

Yeung A, Brockbank W and Ulrich D (1991). Organizational culture and human resource practices. In M. Woodard & W. Pasmore (Eds.), Research in organizational change and development (Vol. 5). Greenwich: JAI Press Inc.

APPENDIX A

Table A1. Chi-square test (**Welders**).

Chi-square (Observed value)	44.9175
Chi-square (Critical value)	14.0671
DF	7
p-value	< 0.0001
Alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Table A2. Chi-square test (**Fitters**).

Chi-square (Observed value)	49.1041
Chi-square (Critical value)	14.0671
DF	7
p-value	< 0.0001
Alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Table A3. Chi-square test (**Scaffolders**).

Chi-square (Observed value)	174.6522
Chi-square (Critical value)	14.0671
DF	7
p-value	< 0.0001
Alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Table A4. Chi-square test (**Riggers**).

Chi-square (Observed value)	26.0028
Chi-square (Critical value)	14.0671
DF	7
p-value	0.0005
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution .

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Table A5. Output of **Wij**

	Welders	**Fitters**	**Grinders**	**Wrappers**
Welders		8.4092	6.7983	7.3371
Fitters	-8.4092		-8.1639	-7.3145
Grinders	-6.7983	8.1639		2.8303
Wrappers	-7.3371	7.3145	-2.8303	

Table A6. p-values from Multiple Pair-wise Comparison.

	Welders	**Fitters**	**Grinders**	**Wrappers**
Welders	1	< 0.0001	< 0.0001	< 0.0001
Fitters	< 0.0001	1	< 0.0001	< 0.0001
Grinders	< 0.0001	< 0.0001	1	0.1875
Wrappers	< 0.0001	< 0.0001	0.1875	1

APPENDIX B

S/N	SAFETY CULTURE QUESTIONAIREE	Always	Often	Sometimes	Seldom	Never
	Safety Management					
SMQ1	New employees receive enough safety training before working alone					
SMQ2	Employee safety suggestions are taken seriously					
SMQ3	Employees receive quick response on their safety suggestions					
SMQ4	Site Management view safety violations very seriously, even when no damage has resulted					
SMQ5	My supervisor is well informed about important safety issues					
SMQ6	Site Management consistently set a good example for safety					
SMQ7	Information needed to work safely is available to all employees					
SMQ8	Employees are encouraged to correct safety problems themselves when possible					
	Actively Caring					
ACQ1	I feel pressure from my co-workers to 'short cut' on safety practice					
ACQ2	Employees should praise each other for working safely					
ACQ3	I observe the work practice of my co-workers to give them feedback					
ACQ4	If I approach my co-workers about their unsafe behaviour, they will react negatively					
ACQ5	Employees in my work area caution each other about unsafe behaviour					
ACQ6	Employees should caution their co-workers about working unsafely					
ACQ7	Besides working safely myself, am willing to do other things to improve workplace safety					
ACQ8	Employees appreciate feedback from their co-workers about their job					
	Safety Perception					
SPQ1	Besides performing their own jobs safely, employees should do other things to help improve workplace safety					
SPQ2	The safety committees' efforts help improve safety					
SPQ3	The site uses a consistent procedure for dealing with employees who violate safety rules.					
SPQ4	Safety audits/inspections are effective in identifying and correcting safety hazards					
SPQ5	When an employee see a safety hazard, they should correct it themselves if possible					
SPQ6	Employees understands the reason behind company's safety rules					
SPQ7	Stress from factors outside my work affects my ability to work safely					

APPENDIX B. Contd.

SPQ8	Employees fully understand the potential hazards of their jobs					